

ISST 10-506 Recommendation Support Document

2 October 2004

This document is a companion to the IFPS Science Steering Team's (ISST) review and proposed revisions of NWS directive 10-506 – Digital Data Products/Services Specification. The ISST has reviewed and addressed the content of the directive for its scientific validity and integrity. Additionally the directive was reviewed for consistency of message, and ambiguities were addressed in several locations. Minor corrections and clarifications have also been recommended. This document contains an overview of the issues addressed, both within the main body and Appendix A, and justification for the proposed changes. This document also presents the groundwork for continued development of Digital Services that may be addressed in future iterations of this directive.

Digital services can and should be used to showcase the strengths of all facets of the NWS, especially during episodes of high impact weather. The NWS is not only creating new digital products and services; but existing products and services are being enhanced through the digital forecast process. The ISST sees this as a challenging and rewarding time for the NWS, and is looking forward to continued work with all parties to improve the digital forecast process and the related products and services offered by the NWS.

Overview

The intension of the directive is to provide guidance to internal and external audiences. For external partners and customers, the directive is intended to be a detailed description and specification of the digital services offered by the NWS, with particular attention to the National Digital Forecast Database (NDFD). It is very difficult to address, at the same time, all the internal issues related to digital services. The ISST recommends that detailed internal aspects of Digital Forecast Production be removed from the directive and addressed via internal memoranda, training materials, and/or policy statements. Changes to internal guidelines related to production of digital products and services are too fluid to attempt to process guidance through the directive system without latency becoming a major stumbling block.

Main Body:

Throughout the main body of the directive attention was paid to delineating the differences between the NDFD and the Digital Products and Services; namely, that the NDFD is a subset of the suite of digital services. Furthermore, the role of the Local Digital Forecast Database (LDFD) was addressed more fully to clarify the levels of service provided by NWS digital products and services.

The ISST strongly recommends further examination of the impacts and resulting solutions to resolution differences between the NDFD and LDFD. Currently, the composition of the NDFD using higher resolution local databases (e.g., 2.5 km grid

spacing) is done by sampling the LDFD values at NDFD locations (e.g., every fourth 2.5 km LDFD grid value – considering both directions), without even simple upscaling, thus losing information contained within the LDFD. This can create discrepancies between local and national verification, and can also result in differences between spatial consistency checks performed nationally versus locally. Possible solutions include increasing the resolution of the NDFD (e.g., 2.5 km grid spacing), establishing a grid spacing of 5 km in the LDFD, or support the difference (to take advantage of its potential strengths) and upscale correctly. Since the issue of forecast system resolution goes beyond the scope of the ISST's 10-506 charge, and into broader digital forecast process issues, we recommend at this time that it be reserved for future discussions and forums.

The ISST prefers the term near-seamless, over seamless, as the description of the collaborated NDFD. A truly seamless NDFD cannot be achieved with input from 117 CONUS and 3 OCONUS WFOs. Furthermore, a well collaborated suite of gridded forecasts should not imply a seamless NDFD, but rather one that is within prescribed tolerances defined by meteorological consistency.

Greater clarification has been made regarding the current roles and responsibilities of the National Centers and River Forecast Centers. At this time, National Centers are not producing forecast grids as direct input into the NDFD. The current role of the National Centers is to provide national guidance, gridded or otherwise, to the WFOs. Additionally, their collaboration roles are more clearly stated.

We also recommend that deference to high impact weather regarding collaboration and update priorities be stressed to emphasize consistency of digital products and services with the NWS core mission.

Finally, the time definitions for the NDFD need to be specified completely, as this directive is the Specification Document for National Digital Services and Products. More specifically, the definition of Day 1 is ambiguous and needs to be defined concisely.

Appendix A: NDFD Element Definitions

Part A – General Forecast Elements

Several changes were made to this bulleted list in order to better set up the specific element definitions in Part B. Many of the bullets addressing internal procedures have been removed under the assumption that the information included in them is better suited for internal memoranda, training documents, and policy statements. Following is a justification of the more important changes recommended for Part A.

Grid Point versus Grid Box

It is critical that internal and external users understand the meaning of an individual (i.e., grid point) value or forecast, especially since the definition's misinterpretation can lead to several forms of element misuse. The forecast grids are not intended to represent a

matrix of infinitesimal point values because metadata, climatic data, and weather forecast information for the exact grid point locations are not known and thus cannot be well represented (e.g., points within regions of complex terrain). Unlike the limited set of MOS station values, grid point values - whether from GFE, forecaster edits, or direct model guidance - are not climatologically calibrated to specific locations to account for systematic biases or microclimatic issues.

Rather, we prefer the interpretation that the element values are representative of the expected conditions for the surrounding grid box. It is too presumptuous to expect that forecasters or guidance have explicit knowledge of what the sub-grid scale conditions will be to interpret the value to be valid only at the specific grid-point location. Furthermore, the grid spacing offered by the NDFD is not a representation of the scales of atmospheric motion being forecasted. The temporal and spatial scales being forecasted are at a much coarser resolution than that implied by the 5 km grid spaced NDFD. Thus the first bullet in Part A has been changed to reflect this important definition. Much of the original first bullet has been deleted, again with the intent being that this material is better conveyed in internal documents.

Continuous versus Complete

The word continuous is not an appropriate descriptor for the NDFD elements. The ISST prefers the use of the word complete, as the elements are available at the prescribed forecast projections for the areas defined by the NDFD. Continuous implies a continuum, not discrete sampling of the database. While true that the LDFD will be nearly continuous (with a time discretization of one hour) the NDFD datasets are sampled at coarser time intervals. Therefore, the word complete best describes the character of the NDFD. The ISST also recommends removing several of the bullets that describe the element's temporal character and value distribution. In terms of temporal character, this information has been included in the element's definition, while value distribution guidelines should be included in internal documents.

Part B – Common Forecast Elements

Appendix A describes NDFD element specifications for use by internal and external partners and customers, whether these elements are official, experimental, or developmental. Therefore, internal elements have been removed for the appendix (e.g., floating PoP). This appendix is not intended to describe variables that are not or will not become part of the NDFD. If additional internal elements are required to produce digital products and services and their derivatives (e.g., text and tabular product), these elements should not be specified in the NDFD element specification. Rather, this information needs to be conveyed to the WFOs and National Centers through internal memoranda, training materials, or policy statements from the NWS regions and/or National Headquarters.

The removal of the floating PoP is consistent with maintaining only NDFD elements within this portion of the directive. Furthermore, the ISST recommends that developers improve the text formatter capabilities to deal with partial period non-null weather

elements and UTC based PoPs through the use of the weather grid (which is stretchable/floating), rather than requiring the production of an additional grid to enable better formatter performance. Thereby the forecasters will not have to produce essentially redundant grids to accommodate inadequacies in the textual and tabular formatters. Also, forecasters should have complete knowledge and control of the elemental values being used explicitly for verification purposes (e.g., PoP12 on the UTC clock).

The ISST understands that adding elements to the suite of gridded services increases the workload of the WFO forecasting staffs. However, efficiency of the gridded forecast process continues to improve, whether it be by improved editing techniques, smartTools, or developing forecaster expertise. Furthermore, any new element that is introduced shall be accompanied by appropriate training, forecasting guidance, and system development. Derived elements should be just that, derived at the National level from the base state variables forecasted at the local level. This ensures derivation consistency for the whole domain and reduces the workload on the local forecast staff. The ISST sees this time as an opportunity to advance our gridded services in a direction that takes advantage of our knowledge base in the field.

Specific Weather Elements:

The subsection labeling associated with the individual elements has been changed from Grid Production Requirements to NDFD Grid Availability to reflect what the directive is actually instructing- namely the temporal distribution of the element as it is contained in the NDFD. However, the internal representation of each element should be continuous (i.e., be represented at every hour over the duration of the required time span) within GFE. Additionally, all elements should be deemed as stretchable (or floating) for all times with the exception of those elements that have specific time definitions (e.g., PoP12, PoP6, QPF6, SnowAmt6, etc). All elements should be near-continuous in time and space within the LDFD, that is elements should be represented at a minimum of the smallest time increment (1 hour) and finest grid spacing (5 km CONUS) required by the production of the NDFD. This ensures completeness of the NDFD.

Max/Min Temperature

The only proposed change is to remove the statement on verification. Otherwise no changes have been made to remain consistent with nationally established verification routines for MOS and locally generated point forecasts- time periods corresponding to daytime maximum and overnight minimum temperature are 0700-1900 and 1900-0800 Local Standard Time respectively. However, since the maximum and minimum temperature can occur any time within in a 24 hour period, it is proposed that in the near future the possible automatic generation (from the hourly temperature grids) of the 24hr Maximum Temperature and 24hr Minimum Temperature grid be investigated. This may also lead to the automatic generation of two additional grids containing the time of the 24hr Max and 24hr Min.

Temperature

No proposed changes.

Dew Point

There is no formal requirement known for the NWS to produce Dew point beyond 72 hours. Further, an informal survey conducted by the ISST to both an intermountain and non intermountain region office reveals there are no customers requesting this parameter beyond 72 hours. Nor is dew point required to derive any other parameter slated to be available for NDFD IOC. Although there does seem to be potential for use by the fire weather community beyond forecast hr 72, until a requirement has been identified and formalized, the ISST does not endorse populating dew point grids beyond forecast hr 72.

Relative Humidity

No proposed changes.

Apparent Temperature

Only a single change to the wind chill threshold values and some minor word changes. Wind chill charts do not offer values greater than 40F, so changed 50F to 40F.

PoP12

Proposed changes to the PoP12 element represent a redirection of complementary association from Floating PoP12 to PoP6. Derivations of PoP12 can be obtained with statistical and scientific validity from PoP6 through 72 hours and then directly supported by forecast guidance through 168 hours.

PoP6

Introducing the PoP6 element represents an important change. Together with the Weather element, detailed information can be provided regarding the probability of precipitation and the expected timing of precipitation, especially through 72 hours. This is the central issue. PoP6 is statistically sound, scientifically valid, and supported by forecast guidance. It is easily understood by both forecasters and users. Further, it negates the need for the Floating PoP12 element. However, some offices may find it helpful to retain this as a local internal grid until the text formatters are enhanced to capture the desired refinement in weather timing. Consequently, it is recommended that Floating PoP12 be eliminated from the 10-506 (Appendix A) since it is not definitely not an NDFD element, and is, at best somewhat difficult to explain.

Sky

No proposed changes. However, as the scope of digital services expands to include more detail in the vertical, and if aviation forecasts come to be derived from the grids, the discrepancy between the NDFD (which requires only opaque cloud layers be depicted)

and surface-based observations (which account for all cloud layers, regardless of opacity) may need to be addressed.

Wind Direction and Speed

Only minor clarifications were made to wind. It is the ISST's understanding that consistency checks do not occur for wind speed between adjacent grid boxes when one of the grid boxes possesses a value less than 8 knots. Wind collaboration threshold calculation should not have a minimum cut-off.

Wind Gust

The proposed changes to Wind Gust eliminate the dependence upon a difference with the wind speed (non-null if the wind gust is at least 10 knots greater than the sustained wind). Instead, the wind gust grid represents expected peak wind during that hour. Rather than assigning the value to zero when gusts are not expected, the value should simply be greater than or equal to the expected wind speed for the respective grid box. This makes the Wind Gust grid independent of the Wind grid and complete spatially.

Weather

Proposed changes to the Weather element definition are significant and support important changes in the PoP and QPF elements. The intent is to be able to provide the necessary information as it relates to the timing (start/ending) of precipitation within the weather grid. Thus, the Weather element is defined to be "floating" in nature. Importantly, expressions may be made hourly to accommodate temporal detail as locally necessary. However, it should be noted that NDFD grid availability for this element has a time resolution of 3 hours through Day3 and then 6 hours through Day7. Also, the Weather element is considered by many to be "dirty"; it is a discrete element having additional descriptors of intensity, coverage, or likelihood. Although not attempted here, it is recommended that future consideration be given for separating the Weather element into two separate elements (Precipitating and Non-Precipitating). This action would give forecasters more flexibility when expressing complex weather situations, while giving the agency an additional opportunity to address the "dirty" aspects of this element.

QPF6

Proposed changes to 6-Hour Quantitative Precipitation Forecast (QPF6) reflect a consistent methodology for gridded QPF forecasts that match both guidance and verification strategies; thereby, eliminating a systematic bias that exists in the current QPF grids, which require non-zero values for PoPs as low as 15%. QPF6 represents the most likely precipitation amount (i.e., median or expected); consequently, this amount is also deterministic and shall be non-zero for PoPs $\geq 50\%$. The element may be non-zero for PoP $\geq 15\%$ and $< 50\%$ under circumstances when the likelihood of precipitation occurrence is high, but coverage is limited (e.g., scattered thunderstorms) and falls within forecaster discretion.

MQPF6

The proposed change to QPF6 as representing the deterministic (non-zero for PoP $\geq 50\%$) or most likely precipitation amount requires that aspects of the conditional QPF be represented separately. The proposed first step in this representation is the 6-Hour Maximum Quantitative Precipitation Forecast (MQPF6). MQPF6 is defined to represent the 90th percentile of the conditional QPF distribution; or in other terms, the 90% likelihood that the observed precipitation amount will be less than or equal to MQPF6 (in comparison the QPF6 represents the 50th percentile). MQPF6 will be non-zero whenever precipitating weather is forecast within that 6 hour period (i.e., PoP $\geq 15\%$). Currently, there is limited guidance related to MQPF6; therefore, additional guidance will need to be developed and provided to the field. However, the ISST sees this as a worthwhile endeavor as the combination of QPF6 and MQPF6 is the first step toward producing gridded forecasts in a probabilistic framework.

SnowAmt6

Only minor clarification has been made to Snow Accumulation. The title was changed to reflect that the snowfall is 6 hour snow accumulation and the amounts are in tenths of an inch.

Part C - Fire Weather Forecast Elements

Min/Max Relative Humidity

No proposed changes.

LAL

Minor change to Table 3 (“Same as #3” changed to “Same as #3-5”). Some offices are currently deriving this grid (from the Wx grid), while others are not. This should be standardized to help reduce spatial discrepancies. It is more advantageous to derive this grid in order to better ensure inter-element consistency.

20 ft wind

This grid is derived by applying a 0.8 multiplication factor to the surface wind speed. Yet, some offices do not even apply the correction, and others apply an alternate factor based on local or regional studies. Due to several issues associated with this grid, it is very possible to eliminate this grid from the NDFD element list and simply use the surface wind in fire weather products, or include the correction factor within text formatters. Namely, research has shown that this 0.8 factor is more closely approximated as 0.92 (Bradshaw et al., 2003 AMS 5th Symposium on Fire and Forest Meteorology). In terms of NFDRS implications, the differences between a surface and 20 ft wind thus may be negligible. Furthermore, this wind height is technically 20 ft above the canopy, which can greatly vary.

Nonetheless, it should be determined if this element is needed, and if so, what correction factor should be used, and whether to include mention of this factor in the 10-506 definition.

Part D – Marine Forecast Elements

Significant Wave Height

The ISST has made two changes to this element: Wave height has been more definitively defined and the Collaboration Threshold, part b has been modified to assign the percentage calculation to the greater of the two adjacent wave height values to remove any ambiguity.

Visibility

There appears to be some confusion with the Visibility “Collaboration Threshold.” The document lists the visibility threshold at 3 nautical miles, yet NWSI 10-303 states:

Visibility. Amend if:

- a. Forecast visibility of 5 NM or more changes to 1 NM or less over a significant part of the forecast area.
- b. Forecast visibility of 1 NM or less increases to 5 NM or more over a significant part of the forecast area.

Thus, the proposed change reflects the amendment guidance as a starting point for collaboration thresholds to more correctly reflect NWSI 10-303.

The range should span from zero to 15 nautical miles with one nautical mile increments. Fifteen nautical miles is the maximum distance that a small boat can see due to the curvature of the earth. Further, the ISST feels this element should not be in this directive since it has not been developed and it is not used in the field at this time.

Closing Remarks

The ISST sees the advancement of digital products and services as a necessary and natural next step in the NWS’s forecast/watch/warning/advisory services. However, the formulation and implementation of such services needs to meet the standards of scientific validity and integrity in order to be an effective means of fulfilling the NWS mission.

The recommendations included in the draft revision should help to clarify and confirm several important factors related to the NDFD and the NWS’ digital forecast process. Yet, the ISST recognizes that a final adoption of these ideas will require considerable dialogue and possible revisions before it can be accomplished. Nonetheless, the ISST feels this will be a worthwhile effort and put us on more solid ground as we approach NDFD IOC this winter.